

# Comparison of Antenna for DTI Rocket Telemetry System

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**Abstract** – This paper focuses on the design, implementation and test of 3 types of antenna for use on DTI's spinning rocket of 122 mm diameter. The antenna is used for transmitting telemetry data to the ground. Here, monopole antenna, patch antenna, and wraparound antenna are designed, realized, tested, and compared based on their return losses and radiation patterns. Finally, an analysis is made on the effect of the antenna and surrounding structure towards the pattern and suitability of use on the rocket based on simulated and measured results.

**Keywords** – Telemetry; POM (Polyoxymethylene); rocket; monopole antenna; patch antenna; wraparound antenna; conformal antenna; return loss; radiation pattern

## I. INTRODUCTION

The design of precise rocket control and navigation depends on many interrelated factors, one of which is the aerodynamic parameters of the rocket. Control engineer has to find the most accurate set of coefficients for his Hardware-In-The-Loop (HITL) Test in order to save time and cost of the development. Many approaches for obtaining such parameters are available, such as through using computer simulation, wind tunnel test, as well as the evaluation of aerodynamic parameter along the flight path on actual firing. Selection criteria whether to use any methods includes budget, availability of test equipment and tools, safety, and time. DTI has started its finding of the parameters from the computer simulation, followed by the verification of results with ones obtained from actual firings. However tests in supersonic wind tunnel are anticipated in the near future.

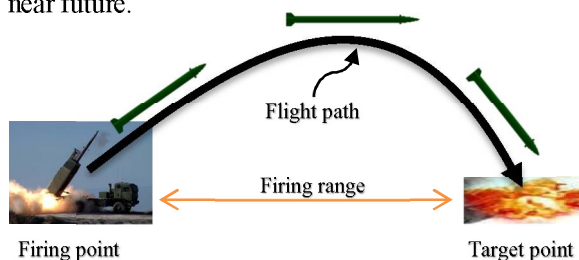


Fig. 1 Rocket flight path evaluation

Airborne data collection system, as shown in Fig. 1, which collects data from certain sensors from the moment the rocket is launched, right until the rocket impacts target point in remote distance. All data from the rocket sensors include position, speed, rotation, acceleration, temperature, as well as many others depending on sophistication of the rocket. These data are sent to a ground station wirelessly using electromagnetic wave as a medium instead of a cable [1].

The antenna system to be used in the rocket must be integrated well onto the rocket and create least alteration to the aerodynamic behavior of the rocket. The challenge is therefore to design a responsive antenna small enough to fit onto the rocket which is rotating all the time.

This paper presents design procedures for 3 types of antenna suitable for fixations inside a rocket, namely monopole antenna, patch antenna, and wraparound antenna. Moreover, DTI-2 which a high-performance medium-range 122 mm diameter (length 1.8 m.) rolling rocket, will be used as our platform. The frequency at 2.465 GHz is used for ample supported equipment and easiness of realization onto a typical FR-4 substrate. Whilst the monopole is fitted in the middle at the tip of warhead fuze (igniter as the tip of rocket) compartment, the other two antenna are placed around the perimeter of the rocket in conformal shape. Not only are they fixed to the structure of the rocket to prevent any damage from high shock and vibration of the in-flight rocket, the one conformed to the rocket surface are coated by thermal insulation to prevent from instantaneous aerodynamic heat. Here, grooves are made onto the rocket surfaces together with Polyoxymethylene (POM) material base plates to which the antenna are fitted, in such a way that the complete antenna configuration does not produce any protruding part from the rocket surface to disturb aerodynamic behavior. At the end, tests are carried out to compare the gains obtained from each type of antenna.